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Podcast-Integrated Physics Teaching Approach: Effects on Student Conceptual Understanding

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Abstract The increasing popularity and accessibility of podcasts captured the attention of many educators, making it an essential part of pedagogy. This study investigated the effects of integrating podcasts in teaching physics student conceptual understanding. It involved two sections of Grade 9 students from a laboratory school in Laguna, Philippines. Physics Conceptual Understanding Test was administered to the control group (CTA group) and experimental group (PIPTA group) for pretest and posttest. The research hypothesis was tested using an independent-samples t-test and normalized gain on the mean posttest scores of the students. Results showed that there was a statistically significant difference between the two groups in terms of conceptual understanding and the individual normalized gain of the students. Entries from student's online journal verified the results of the study. To conclude, podcasting was effective in eliciting student conceptual understanding in physics since its simplicity and flexibility as a learning tool offered a unique way to enhance learning. Recommendations to improve the intervention and the quality of podcasts, as

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well as its implications to pedagogy were also indicated for future researches.

Keywords: conceptual understanding, instructional material , physics education, podcast

Introduction

Over the past decades, the world has witnessed greater advances on a more rapid pace in science, commerce, telecommunication, and in other countless areas. Looking at the Philippine classrooms however, only traces of such advances can be observed especially in the pedagogical aspects of the country's basic education. Globally, the Philippines lags behind other countries in terms of the quality of education, particularly in science education. According to the World Economic Forum (WEF) Global Competitiveness Report (2014), the Philippines ranked 70th out of 144 participating countries in terms of the quality of mathematics and science education. This standing was also evident in the Trends in International Mathematics and Science Study (TIMSS, 2003). The Philippines ranked 34th out of 38 countries and 43rd out of 46 countries in comparing the Grade 8 students' performances in mathematics and science, respectively. Results of the same international survey indicated that the Philippines placed in a disadvantaged position of 23rd out of 25 participating countries in both Grade 4 mathematics and science.

In particular, achievements in physics of Filipino students appeared to be below the international standards (Orleans, 2007). This poor performance in physics can be attributed to many different factors affecting student learning. Such factors included the students' lack of self-confidence and inability to solve physics questions correctly, incompetent teachers, and lack of engaging instructional materials for physics classes (Olusola & Rotimi, 2012).

As a type of technology-based instructional material, podcast remains a resource yet to be tapped to better facilitate learning among students (Scutter, Stupans, Sawyer, & King, 2010). It is becoming more popular as an educational tool, as it deviates from its original purposes in entertainment and journalism. In fact, in 2005, the New Oxford American Dictionary has declared the term "*podcast*" word of the year. By definition, podcast is a digital media file that plays audio and/or video. It can be downloaded from a website and be played on any portable players that are designed to play sound (Salmon, Mobbs, Edirisingha, & Dennett, 2008). Cebeci and Tekdal (2006) expressed these features in a formula as follows:

> *Podcasting = Web syndication (RSS, Atom) + Audio content (talk shows, music, news and certain learning resources…) + Mobile devices (MP3 players, PDAs, cell phones…) (p.48).*

The increasing popularity and accessibility of podcasts captured the attention of many educators around the world, making it an integral part of the pedagogical context. Edirisingha, Rizzi, Nie, and Rothwell (2007a) pointed out three main reasons why podcasting is becoming more popular in education. First, it was being used in the entertainment and journalism industries for it was primarily intended to deliver information. With the benefits of its accessibility over the internet, it became a low-cost and low-barrier tool for disseminating information (Chan & Lee, 2005). Second, there was an increasing MP3 player ownership and usage. This trend was reflected on a survey conducted last 2012 by the Ipsos Media Atlas Philippines Nationwide Urban among Filipinos. Results showed that 30% of the Filipino urban population said that mobile phones are necessities in life, particularly for communication purposes. Aside from its main usage, mobile phones were also used for games (22%), as a digital camera

(25%), and as an audio or MP3 player (23%) (Roa, 2012). Such findings affirmed that many Filipinos nowadays are capable of utilizing their mobile phones to access various audio files. Finally, there is an increasing availability of free downloadable softwares and tools to create podcasts and distribute them on the internet. Some of these available websites include iTunes by the Apple Corporation, TED Talks, Classroom 2.0 LIVE, and Google Educast, among others.

Research findings have reported that integrating podcasts in pedagogy resulted to increased, positive, and enhanced learning among students because it encouraged active learning inside the classroom (Chan & Lee, 2005; Edirisingha et al., 2007a; Edirisingha, Salmon, & Fothergill, 2007b; Morris, 2010; Scutter et al., 2010). As it is tightly coupled with lecture discussions, podcasting is a powerful tool to complement traditional resources on a course. It serves as a supplementary tool to enrich content previously presented in class, hence increasing the level of understanding among students (Dyson, Litchfield, Lawrence, Raban, & Leijdekkers, 2009; Fernandez, Simo, & Sallan, 2009). Aside from the students, teachers also benefit from using podcasts as these tools served as alternative means of delivering content inside and even outside the classroom (Edirisingha et al., 2007a; Edirisingha et al., 2007b; Gurcay, Wong, & Chai, 2013; Hill, Nelson, France, & Woodland, 2012; Ng'ambi & Lombe, 2012; Scutter et al., 2010).

Furthermore, the use of podcasts bridges gaps in distance learning since it can augment face-to-face lectures and can overcome language difficulties (Dyson et al., 2009). This new and emerging technology makes mobile learning possible since learning is no longer tied to a particular location. Ng'ambi and Lombe (2012) also pointed out that podcasting offers flexibility and self-control to the learners.

As the students explore podcast as a new learning tool, they also develop greater confidence and a sense of autonomy in building their own knowledge. Clearly, the use of podcasts promotes an "*anytime, anyplace education*" (Chan & Lee, 2005).

Purpose of the Research

As the use of digital technology become more embedded in today's daily routine, educators are now challenged to look for innovative ways to teach the 21st century learners. To respond to this need, the authors of this paper are motivated to further explore podcasting in the context of the Philippine educational system. Seeing podcasts as a promising learning resource, this study aimed to determine if its integration in teaching different physics concepts to Grade 9 high school students could yield higher levels of conceptual understanding. This research problem can be answered using two statistical measures namely; the independent samples t-test and individual normalized gain of the posttest mean scores of the students in the Physics Conceptual Understanding Test.

Methodology

Research Design

The study used a quasi-experimental two-group pretest-posttest design involving two heterogeneous intact classes. One class was exposed to the Conventional Teaching Approach (CTA) while the experimental group was exposed to Podcast-Integrated Physics Teaching Approach (PIPTA). Prior the intervention, the Physics Conceptual Understanding Test (PCUT) was administered to both groups for pretesting. Then, the intervention was conducted for eight weeks, wherein 13 podcast episodes were introduced to the students

of the PIPTA group. After which, the same instrument was given to both groups to measure the difference in the student's conceptual understanding in physics.

The research design of this study is as follows:

PIPTA	O_1	X	O_1'
CTA	O_1		O_1'

Where:

X = INTERVENTION: Podcast-Integrated Physics Teaching Approach (PIPTA)

O_1 and O_1' = Physics Conceptual Understanding Test used as pretest and posttest, respectively

Participants

Grade 9 high school students from a laboratory school at Paciano Rizal in Bay, Laguna, Philippines served as the participants in the study. Section C was assigned as the control group (CTA group); while, Section B served as the experimental group (PIPTA group) of the study. Each heterogeneous class was composed of 41 students, with age ranges from 14-16 years old. Both groups comprised equal number of male and female, with 18 and 23 students each, respectively.

Development of the Physics Podcasts

The *"Physics Station"* is a collection of 13 podcast episodes developed by the researchers. Each episode lasted 15-20 minutes which featured the conversations of the two hosts, Nick and Chloe about the different physics topics covered, namely: Work, Power, Energy and its Forms, Law of Conservation of Mechanical Energy, Center of Gravity, Torque, Uniform Circular Motion, Law of Planetary Motion, Law of Universal Gravitation, and Heat and Temperature.

The researchers followed the four stages of podcast development as identified by Aristizabal (2009): (1) Planning and Organization, (2) File Production, (3) Web Subscription and Publication, and (4) Delivery and Feedback. As a result, each episode contained eight different segments, which were not necessarily be in order for all episodes: (1) objectives of the podcast, (2) opening segment, (3) conversation of the hosts, (4) discussion of the physics concepts, (5) segment break, (6) thinking time, (7) recall, and (8) closing segment.

Post editing and content mixing of the recordings were done using an audio-editing software called *Audacity*. The finished episodes were then assessed by the experts for a second round of evaluation. These podcasts episodes were uploaded to a group in *Edmodo*, a web-based networking platform for teachers and students. Only the experimental group has an exclusive access to the podcast collection to eliminate the contamination of the intervention.

Instruments

The Physics Conceptual Understanding Test (PCUT) is a researcher-made multiple-choice examination, which includes the same topics covered in the podcast episodes of the *Physics Station*. PCUT items consisted of four choices (A, B, C, D) in which the students were expected to choose one correct answer. It was validated by a panel of physics education experts with remarkable qualifications. The panel included a professor from University of the Philippines Diliman with more than 10 years of experience in teaching Physics and Physics education, both in secondary and tertiary levels. Also, two professors were selected from University of the Philippines Los Baños, one who is the coordinator of college students taking BS Mathematics and Science Teaching – Major in Physics, while the other professor has been teaching Physics and Applied Physics for almost 15

years. Lastly, a Science Specialist II from the University of the Philippines National Institute for Science and Mathematics Education Development (NISMED) evaluated and revised the instrument. From a 65-item test, the instrument was reduced to 45 items as revised based on the comments of the experts. The result of the reliability analysis yielded a Cronbach's alpha value of .829, interpreted as within the standard of a reliable test.

Intervention

The research was conducted from February to April of the school year 2015-2016. For both groups (CTA and PIPTA group), all lessons followed the 4A's teaching approach, which comprised the following major parts: Activity, Analysis, Abstraction, and Application. The difference between the two approaches was shown in Figure 1.

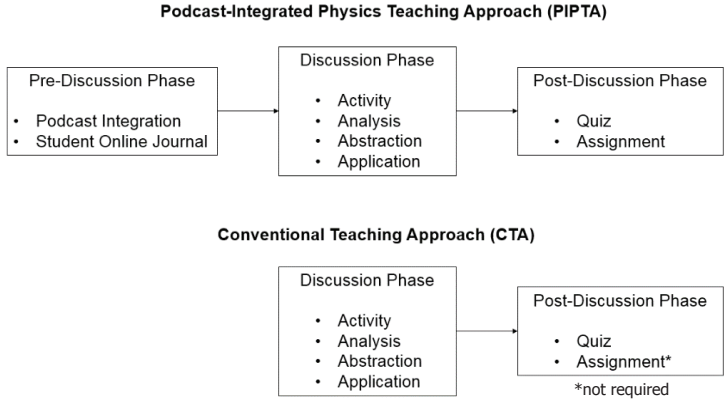

Figure 1. Comparison on the flow of instruction for the two teaching approaches.

Podcast-Integrated Physics Teaching Approach (PIPTA).

The students exposed to PIPTA were introduced to the podcast episodes before classroom discussion. They were required to join a closed online group in *Edmodo* so that they could access such instructional materials. They listened to the episode and accomplished their assignment afterwards. Moreover, they evaluated their overall learning experience in using the podcasts and wrote them on their online journals.

Students were also encouraged to take down notes on important keypoints that were mentioned in the podcast episode. If they experienced difficulty understanding the concepts, they were instructed to replay a segment or repeat the whole episode if they wanted.

Conventional Teaching Approach (CTA).

This teaching approach was employed to the control group of the study. Unlike the PIPTA group, the conventional teaching approach included two out of the three phases, namely: Discussion and Post-Discussion phases only. Since the CTA group was not exposed to podcasts, they no longer underwent the Pre-Discussion phase.

After the eight-week intervention, all 13 podcasts were also introduced and given to the control group as supplementary materials. This debriefing method was done to ensure equality among the students who participated in the study. Instead of actual re-teaching the entire coverage, the students of the CTA group used the podcasts as reviewers and assessment tools in preparation for their final examination. In addition, they were not required to submit written assignments and personal insights on online journal.

Data Analysis

The study utilized both quantitative and qualitative analysis of data. To establish the initial comparability of the CTA group and PIPTA group, a two-tailed t-test for independent samples on the PCUT mean pretest scores was employed, as shown in Figure 2.

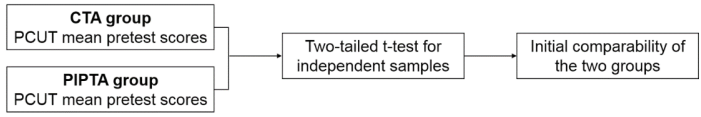

Figure 2. Data analysis framework before the intervention.

After the intervention, the PCUT mean posttest scores were subjected to the same statistical test in order to determine if there was a significant difference between the two groups in terms of student conceptual understanding. The average normalized gain was also computed to further analyze the difference between the two groups. In addition, independent-samples t-test was also employed using the individual normalized gain scores of the students, as shown in Figure 3.

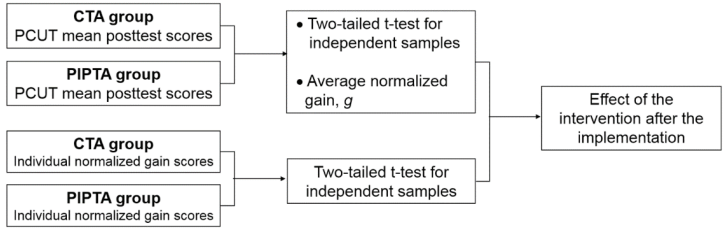

Figure 3. Data analysis framework after the intervention.

Results and Discussion

Initial Comparability of Student's Conceptual Understanding in Physics

In determining whether the CTA group and PIPTA group were comparable before the intervention, the pretest mean scores in Physics Conceptual Understanding Test (PCUT) were subjected to two-tailed t-test for independent-samples. Table 1 shows the mean scores and standard deviations of both groups, and the computed t-value at 5% significance level. Since the p value of the Levene's test, F (80) = 1.52, p = .221, is greater than the significance level (p = .05), the variances are assumed to be equal. Satisfying this assumption, the analysis proceeded to independent-samples t-test.

Table 1. Mean pretest scores of PIPTA and CTA groups in Physics Conceptual Understanding Test

Group	Mean	Standard deviation	t	df	Sig. (2-tailed)
PIPTA	19.6	4.52	1.61	80	.112
CTA	21.4	5.34			

Note: PCUT Perfect Score = 45 points

For the independent-samples t-test, the result indicates that the t-test fails to reveal a statistically reliable difference between the mean pretest scores of the students from the CTA group and PIPTA group, t (80) = 1.61, p = .112, in the Physics Conceptual Understanding Test. Thus, the two groups are comparable prior the intervention.

Furthermore, comparing the mean scores of the two groups, the CTA group (M = 21.4, SD = 5.34) has acquired a higher mean score than the PIPTA group (M = 19.6, SD = 4.52). However, it can be noted that for a 45-item multiple-choice examination, both groups obtained scores less than

50% of the total items. Such low scores can be attributed to the fact that the physics concepts were not yet discussed to them. Most of the students relied solely on their prior knowledge or guessed the answers to the items. In effect, any significant changes in the student's scores might be attributed to the proposed teaching approach.

Effects of Podcast-Integrated Physics Teaching Approach on Conceptual Understanding in Physics

For eight weeks, the experimental group was exposed to podcast-integrated physics teaching approach, while the control group was exposed to the conventional teaching approach. After the intervention, the Physics Conceptual Understanding Test (PCUT) was re-administered to both groups as posttest. To determine if there was a significant difference between the mean posttest scores of the two groups in terms of the conceptual understanding in physics, an independent-samples t-test was employed. Results of this statistical analysis are presented in Table 2.

The variances were assumed not to be equal because the p value of the Levene's test, $F(78) = 4.36, p = .040$, was less than the significance level ($p = .05$). At 5% significance level, the computed p value was less than the significance level, $t(78) = 3.18$, $p = .001$, for one-tailed analysis. This indicates that the t-test reveals a statistically reliable difference between the two groups. Thus, there was a significant difference in the mean posttest scores in the physics conceptual understanding test of the students between the PIPTA and CTA group.

Furthermore, it can be noted that there is a 4-point difference between the mean posttest scores of both groups. This shows that the PIPTA group ($M = 33.1$, $SD = 6.01$) acquired a higher mean posttest score than the CTA group ($M = 29.2$, $SD = 5.14$).

Table 2. Mean posttest scores of PIPTA and CTA groups in Physics Conceptual Understanding Test

Group	Mean	Standard Deviation	t	df	Sig. (1-tailed)
PIPTA	33.1	6.01	3.18	78	.001*
CTA	29.2	5.14			

** $p < .05$*

As another method of analysis, the normalized gain, *g*, was employed to verify the significant difference between the two groups in physics conceptual understanding. Many studies have been utilizing this tool for the characterization of conceptual improvement in introductory physics courses (Stewart & Stewart, 2010). As the proponent, Hake (1998) pointed out that "*as a rough measure of the effectiveness of a course in promoting conceptual understanding"* (p.65), the normalized gain became the standard measure for reporting scores on research-based concept inventories. It can be computed as:

$$\langle g \rangle = \frac{\textit{mean posttest score} - \textit{mean pretest score}}{\textit{maximum possible score} - \textit{mean pretest score}}$$

As illustrated in Figure 4, the computed average normalized gain for the PIPTA group is <g> = 0.53 while <g> = 0.33 for the CTA group. Both values are within the medium range, from 0.3 to 0.7. These perceived learning gains were because of the discussion of the physics topics to the students. But evidently, since the PIPTA group has a higher normalized gain compared to the CTA group, the difference can be attributed to the learning supplemented by the physics podcasts throughout the intervention period. Such increased learning was manifested in the improvement of their posttest scores relative to the PCUT pretest scores.

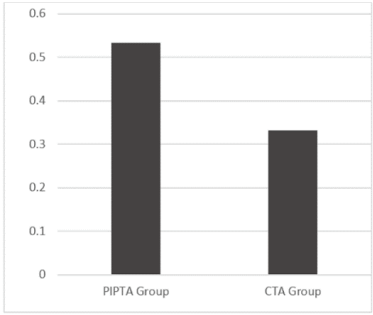

Figure 4. Average normalized gain, <g> of PIPTA group and CTA group in PCUT.

In terms of student's performance in PCUT, it was also observed that some students from the PIPTA group acquired higher posttest scores compared to the CTA group. In fact, six students of the PIPTA group had scores greater than 40/45, among which was a student who scored 43/45. These findings and observations can be associated to the proposed teaching approach or the integration of podcasts in the discussion of physics concepts.

Furthermore, the individual normalized gain scores of the students were subjected to independent-samples t-test. This procedure determined whether there was a significant difference between the two groups in terms of their individual normalized gain scores. At 5% significance level, the computed p value was less than the significance level, t (80) = 4.34, $p < .001$. With the assumption that the variances were equal, the p value of the Levene's test, F (80) = .003, $p < .001$, was less than the significance level ($p = .05$). This indicates that the t-test reveals a statistically reliable difference between the two groups in terms of the individual normalized gain scores of the students. The result of this analysis is presented in Table 3.

Table 3. Independent-samples t-test using the individual normalized gain scores of the students in CTA group and PIPTA group

Group	Mean	Standard Deviation	t	df	Sig. (1-tailed)
PIPTA	.533	.222	4.34	80	.000*
CTA	.304	.255			

** significant @p < .05*

Such results are in line with the common findings of some researches about podcasting in education (Dyson et al., 2009; O'Bannon, Lubke, Beard, & Britt, 2011; Parson, Reddy, Wood, & Senior, 2009; Taylor & Clark, 2010). When used as a supplementary material, podcasts can enrich content previously presented in class (Parson et al., 2009). In effect, it increases the level of understanding among the students who are using them. For this study, the group exposed to the podcast-integrated teaching approach had significantly improved in terms of their physics conceptual understanding compared to the group exposed to the conventional teaching approach.

Correspondingly, all of these findings were supported qualitatively through the actual comments of students on their online journals. Emerging themes were observed based on their personal insights. Primarily, they perceived that the use of podcasts helped them increase their knowledge about the lessons. Even without prior discussion, students already understood the lessons well. In effect, they felt that their learning improved after listening to the podcasts.

> Student 3: *"I think listening to the podcasts is fun. It helps me broaden my knowledge and gives a good briefing or walkthrough of our next lesson in IS9. I think it is an effective way of studying and learning."*

> Student 37: *"Yes, I enjoyed! I feel like a genius in physics now!"*

Another common theme observed was the response of the students to podcasts as a unique tool for learning. In a study conducted by Aguiar, Carvalho, and Carvalho (2009), they evaluated the impact and acceptance of podcasts among biology students. According to the results of their study, 81% of the students showed interest in learning even during the first trial of the podcasts. They mentioned that the positive acceptance of the students was due to the new kind of innovation introduced to them. Students had a tendency to pay more attention to the technology that was new to them.

In this study, since the use of podcasts was newly introduced to to the experimental subjects, the interest of the students to study had increased. The willingness to assimilate this new technology into students' learning was considered another factor for their positive response toward using podcasts. In fact, a student had this feedback:

> Student 12: *"The experience of listening to podcasts has been great for me because I discovered another media in which I can learn. Since technology is used for us to learn, I look forward to better and more fun avenues of learning."*

The effect of taking notes while listening to the podcasts was another factor observed from the comments of the students. The following comments were consolidated to support this claim.

> Student 41: *"I enjoyed listening to the podcasts! I jot down notes while listening… It feels great to learn something!*

> Student 38: *"I actually enjoyed listening to the podcasts because aside from being greatly informative, the hosts also have some sense of humor, making some terms quite easier to understand…While listening, I took down some notes in the iPad, so remembering won't be much of a problem..."*

> Student 33: *"...Yes, the act that it takes effort to take down notes which results to repeating the audio over and over again, we will surely learn and probably memorize it somehow…"*

In this study, the researchers encouraged the students to take down important concepts mentioned in the podcast episodes. Most of them took notes while listening and used them during classroom discussions. In effect, their motivation to learn physics was enhanced. Some students also pointed out the benefits of being able to stop and replay the podcast in case they missed some parts or if they wanted to listen to it again. They reported valuing the ability to re-listen to the podcasts to help them increase their conceptual understanding. This flexible aspect of podcasting allows the students to make decisions on the learning context that suits them (Clark & Taylor, 2010). Students can modify their own pace in learning, thus increasing their understanding about the lessons.

> Student 27: *"...Yes, just by listening to it, I know I can improve my study habits with the help of course of the notes…"*

Furthermore, listening to the podcasts prepares the students for the next classroom discussion. It was observed that their participation increased.

> Student 6: *"Listening to this podcast again is so fun even though we have already discussed*

> *it in class. Listening to podcasts before class makes me ready for recitation. I will rate my participation, 8/10."*

> Student 1: *"Listening to these podcasts is truly a big help for the coming lecture. It gives us the idea and things about the topic to be discussed in advance, letting us participate more. And I like participating in our class because I really find it fun."*

The increase in student participation in class can also be one of the advantages of podcasting. For this study, since the podcast episodes were given before the start of every discussion, it was observed that the students were no longer worried even if new topics were introduced to them. Hence, students' level of anxiety was decreased. With the same findings, podcasts provided advance exposure to conceptually difficult topics covered during class. As a result, students from the PIPTA group were more engaged to the lessons because their anxiety level was decreased. This was exhibited in a comment mentioned by a student:

> Student 10: *"Personally, this is the first time that I've heard about "Torque", so I expected a lot since I will be encountering a new topic. And through the podcast, I think the topic got through me well… I think, for myself that I am better than prepared to participate and answer in class since I'm sure of my answer."*

Overall, most of the students gave positive feedbacks on their experience in using podcasts. This is similar to the findings of Clark, Sutton-Brady, Scott, and Taylor (2007) in the survey they conducted among marketing students. Results from their research indicated that 96% of the students felt that they had gained learning benefits from using

podcasts. Likewise, in this study, majority of the students from the PIPTA group find podcasts to be informative and helpful especially in studying their lessons. Their learning performance significantly increases since they are able to prepare and study before the class discussion.

However, despite all of these positive feedbacks on using podcasts, few students (3 out of 41) also cited some drawbacks in utilizing them as instructional materials. Since podcast episodes were uploaded online, two students had difficulty accessing them because of their intermittent internet connection at home. This technical inconvenience may affect student's learning and motivation. With that, it is recommended to distribute such instructional materials offline.

Another student suggested to incorporate videos and animations while listening to the podcasts:

> Student 15: *"It was better than just reading but I would have enjoyed and be more alert if it were a video. Because personally, I would be more attentive if it was a video. Sometimes while listening I had some parts wherein I had a hard time picturing and understanding what they were saying."*

For future studies, developing enhanced podcasts or vodcasts – incorporating video and/or Powerpoint presentation in a podcast can be investigated. Such problems encountered can be addressed for future studies in order to attain maximum learning experience for the students.

Clearly, students have enjoyed listening to podcasts because of its unique way to deliver information. Hence, there is a significant effect of integrating podcast to student's conceptual understanding physics, as supported by the statistical measures employed in the study. The following pictures show how students interact with the podcasts when

they were allowed to download it and listened to them inside the classroom (Figure 5).

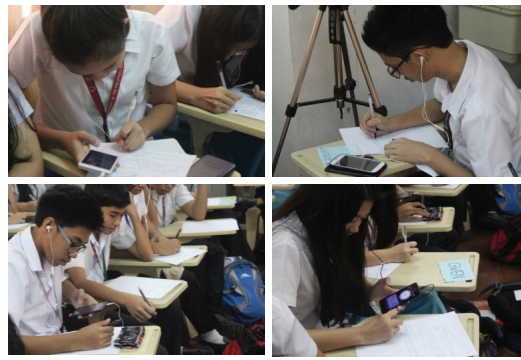

Figure 5. Students listening to physics podcasts inside the classroom.

Conclusion and Recommendations

This research investigated the effects of podcast-integrated teaching approach on student conceptual understanding among the Grade 9 high school students in a laboratory school at Paciano Rizal in Bay, Laguna, Philippines. Based on the results of the preceding analyses, there were four general findings established in the study. First, there was a significant difference in the mean posttest scores between the students exposed to podcast-integrated physics teaching approach and those exposed to conventional teaching approach in terms of conceptual understanding in physics.

Furthermore, in terms of the average normalized gain, PIPTA group scored higher compared to the CTA group, with $\langle g \rangle = 0.53$ and $\langle g \rangle = 0.33$, respectively. As another statistical analysis used, independent-samples t-test was employed to determine whether there was a significant difference between the two groups in terms of their normalized gain scores. Correspondingly, the result was found to have a significant difference in the individual normalized gain scores between the two groups, $t\,(80) = 4.34$, $p < .001$.

Lastly, several common themes emerged based on the student's reflections on their online journals. Students perceived an increase in their knowledge even without actual classroom discussion. In addition, since podcasting offered a new learning strategy for the students, they tend to have positive feedbacks in using them. Such response could be attributed to their willingness to assimilate new technology in learning. Also, listening to podcasts caused an effect on the note taking abilities of the students. The flexible aspect of podcasting that allows the students to replay or re-listen led to an enhanced participation and motivation to learn physics. Student's level of anxiety to difficult concepts was also decreased because listening to podcast prior the classroom discussion enabled them to be exposed to conceptually difficult topics in physics.

In conclusion, integrating podcasts in teaching physics concepts is an effective supplementary tool in enhancing student's conceptual understanding. One of the most important pedagogic characteristics it offers is learning by listening. With podcasting, learning is no longer a sedentary activity. Its ease of accessibility, simplicity, and flexibility transforms the educational system to a higher level. Considering all the observations and comments of the students who used them, listening to podcasts made learning more personal. Thus, allowing the students to improve and maximize their learning potentials. Not only for the students, but podcasting also enabled teachers to innovate on their teaching and assessment procedures and allowed them to deliver content using alternative resources.

The following are the recommendations to address unanswered questions or issues in the study. Accessing the podcasts online can be a pressing problem especially for students who do not have internet connection at home. The strategy to distribute such instructional materials offline can also be studied in the future. This is leaning outside the

study environment, as it concerns availability of facilities and infrastructure where podcasts can be utilized. Nevertheless, education and pedagogy must take advantage of the rapidly advancing technology, towards a more efficient knowledge transfer.

In the production of the audio podcasts, it is recommended to limit the length of each episode up to 10 minutes or less only, so as not to bore students especially the younger ones. Voice actors should sound friendly and lively to catch the student's attention and interest. The use of music, in which students can relate to, may also improve the overall appeal of the podcasts (Aguiar et al., 2009). Moreover, since most of the students are visual-learners, it is also highly recommended to incorporate videos, *PowerPoint* presentations and animations to the podcasts, making them vodcasts or enhanced podcasts.

Another study that can be investigated is the potential of podcasts for stand-alone mode of instruction, since the study utilized them as supplementary materials given in a blended/flipped learning setup that still incorporates traditional classroom discussion. It is suggested that students will no longer be required to have a face-to-face instruction; instead, every discussion is recorded in podcasts.

To further advance the understanding about the usage of podcasts, more researchers are needed to discover best practices of integrating new technologies, particularly podcasts into the classroom setting. With the goal to enhance the learning environment and improve the quality of education, researchers are challenged to explore and initiate other educational reforms through technology.

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